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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/996,118	11/27/2001	Chuan-cheng Cheng	01-695/LSI1P184	5362

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LSI Logic Corporation  
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Milpitas, CA 95035

EXAMINER

RAO, SHRINIVAS H

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 08/27/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Applicati n No.

09/996,118

Applicant(s)

CHENG ET AL.

Examiner

Steven H. Rao

Art Unit

2814

-- The MAILING DATE of this c mmunication appears on the cover sh et with the correspondence address --

**Peri d f r Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 18 June 2002.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 6,7 and 9-11 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☐ Claim(s) 6-7,9-11 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

***Response to Amendment***

Applicants' amendment filed June 05, 2002 has been entered on June 18, 2002.

Therefore claims 6, 7, 9 and 10 as amended by the amendment and presently newly added claim 11 are currently pending in the application. Claims 1-5 and 8 have been cancelled by the amendment.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 6-7 and 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over McTarr (U.S. Patent No. 5,939,788, herein after McTarr) and Robinson et al. (U.S. Patent No. 6,054,172 herein after Robinson) both previously applied for reasons previously set out and those set out below.

McTarr and Robinson teach substantially all the steps presently recited in claim 6 as previously stated and see the following response to argument section for all of the applicants' contentions.

Therefore the previous rejection of claim 6 is maintained and made Final.

Applicants' did not separately argue the patentability of dependent claims 7, 9 and 10 and therefore it is assumed they argue the dependent claims are alleged to be allowable because they depend upon allegedly allowable claim 6.

However as shown above claim 6 is not allowable, therefore claims 7,91-0 are also not allowable.

Presently new claim 11, recites wherein the Cooper has a thickness within the range of 0.3 to 2.0 um and the aluminum has a thickness within the range of 0.5 microns to 3.0 um. ( McTerr col.22 lines 60 100-800 Angstroms i.e. 0.01 to 0.08 um) and claim 26 cooper 100 –2000 angstroms thick i.e. 0.01 to .02 um). Therefore without a showing of criticality or unexpected results the recited range of thickness is obvious in view of previously described overlapping ranges.

Therefore claims 6,7,9-11 are rejected for reasons previously stated and those stated above.

### ***Response to Arguments***

Applicant's arguments filed 6/18/02 have been fully considered but they are not persuasive for the following reasons :

Applicants' argue, " neither reference even hints at a two layer interconnect line with the upper layer being aluminum, not cooper. "

McTerr in col. 10 lines 23-44 states :

In still another embodiment, there is provided a via level aluminum/copper dual damascene interconnect on a silicon substrate comprising a first insulating layer having a conductive metal plug therein; a second insulating layer deposited over the first insulating layer and the conductive metal plug and having a first opening overlying the first insulating layer wherein the first opening lies over at least part of the conductive metal plug; a wetting layer for aluminum deposited on the inside surface of the first opening; an aluminum layer deposited over the wetting layer for aluminum to fill the first opening; a third insulating layer deposited over the second insulating layer and the aluminum layer and having a second opening overlying the second insulating layer wherein the second opening lies over at least part of the aluminum layer; a copper diffusion barrier layer deposited on the inside surface of the second opening; an aluminum wetting layer deposited over the copper diffusion barrier layer; and a copper layer over the aluminum wetting layer to fill the second opening, wherein said aluminum wetting layer consists at least in part of a copper aluminum alloy after the copper layer is deposited over the aluminum wetting layer.

In still another embodiment, there is provided a via level

Therefore it is clear that McTarr teaches two layer interconnect with an Aluminum upper layer.

It is noted that applicants' presently recited claims do not exclude other layers.

Applicants' next argue that , " whatever aluminum layers are mentioned In McTarr and Robinson serve as barrier layers or bonding layers between the semiconductor and copper and make no real contribution to the overall resistance of the interconnect line and are always below the copper layer."

It is well known to a person of ordinary skill in the art that Copper by itself has a high contact resistance with silicon and creates all kinds of problems if it migrates into device areas and that Aluminum overcomes the problems of using copper by itself.

McTarr in col. 21lines 50-55 describes that the Aluminum forms a  $Cu_n Al$  alloy thus reducing the contact resistance of the  $Cu_n Al$  alloy than the Cooper metal by itself.

The fact that Aluminum layer is always below the Cooper layer may or may not be true, but however is not relevant because applicants' claim do not exclude the Aluminum layer being below a second cooper layer.

It is noted that Applicants' are engaging in piecemeal analysis of the references, it has been held that one cannot show non-obviousness by attacking references individually where, as here, the rejections are based on the combination of references. In re Keller, 208 USPQ 871 (CCPA 1981).

Applicants' next argue that McTERR does not suggest that the thickness of the Copper can be reduced if a thick layer of aluminum is layered over the copper .

The above cannot be given patent able weight because none of the limitations argued to differentiate from the McTERR reference are recited in the claims. It is well settled that " it is the claims that define the claimed invention and it is claims, not specification that are anticipated or unapentable. Constant V Advanced Micro-Devices Inc, & USPQ 2d 1064.

Further as shown above under rejection of claim11 McTERR in col.22 lines 60 100-800 Angstroms i.e. 0.01 to 0.08 um and claim 26 cooper 100 –2000 angstroms thick i.e. 0.01 to .02 um).

Applicants' next argue, "that Robinson does not even mention the possibility of making the top layer of the interconnect, along its entire length, from aluminum."

It is noted that rejection was based on the combined teachings of McTERR and Robinson and McTERR teaches making the top layer of the interconnect, along its entire length, from aluminum and therefore whether a single reference Robinson teaches this

limitation is not relevant as the combined teachings of the references clearly teaches the alleged limitation.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action.

As the same references as previously applied are also used herein this forms a separate basis to make this action Final.

Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Steven H. Rao whose telephone number is (703) 3065945. The examiner can normally be reached on 8.00 to 5.00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chaudhuri Olik can be reached on (703)3062794. The fax phone numbers

Art Unit: 2814

for the organization where this application or proceeding is assigned are (703) 7463926 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 3067722.



Steven H. Rao

Patent Examiner

August 23, 2002



PHAT X. CAO  
PRIMARY EXAMINER